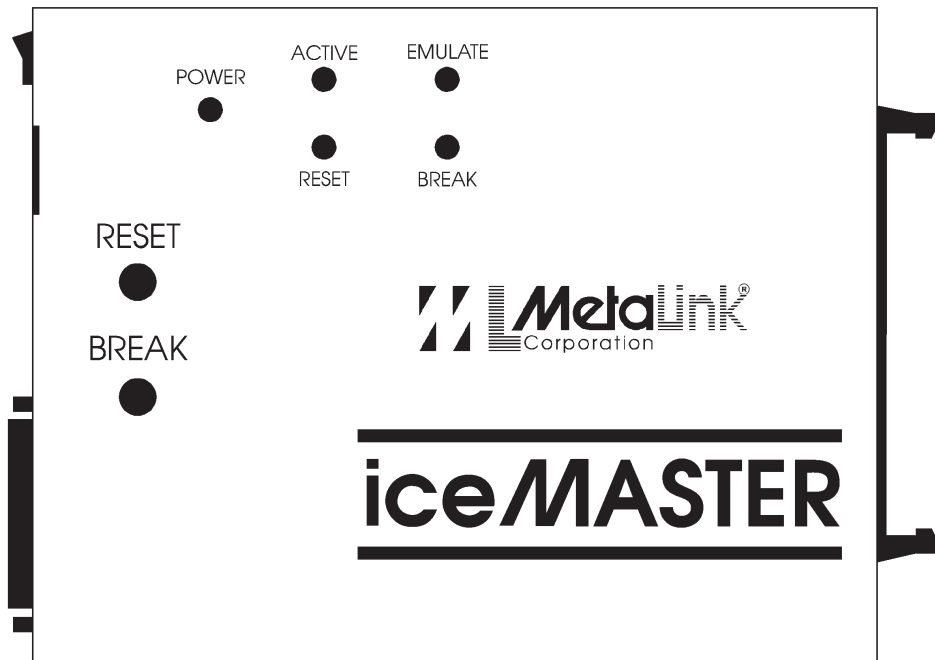

iceMASTER[®] AD
User's Manual
for Microsoft[®] Windows[®]



Document Version: 1.01

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Chapter 1: Introduction

The Emulator

The iceMASTER AD emulator is an in-circuit emulator controlled by an IBM PC (or compatible) running the Windows operating system. The iceMASTER emulator is an integral part of the development engineer's toolbox, with applications in software development, hardware integration, manufacturing test and field service.

The emulator can be operated in a target system in place of the microcontroller, or independently in stand alone mode. Stand alone mode allows you to emulate hardware and/or execute code without a target system (provided no interaction with external devices is needed).

Hardware designers may use the emulator to develop and debug their designs. All available features of a given device are accessible interactively, as well as through your application programs. Software designers have complete emulation capability as well. The emulator will execute your code just like the real part because it uses the real part for emulation.

Recommended References

Several additional references can be of help to you as you progress through the development process. The data book and programmer's guide for the microcontroller you are using provide essential information. You will also need the programmer's manual for the development language you are using.

What You Need To Know

Throughout this manual it is presumed that you have a working knowledge of:

- 1) the family of microcontrollers you are emulating
- 2) the IBM PC (or compatible) as an engineering tool
- 3) a development language (e.g., Assembly Language, C or PL/M)
- 4) Microsoft Windows 3.11, Windows 95 or Windows NT 4.0.

A few of these topics are discussed in this manual as a means of illustrating a particular feature or facet of the iceMASTER emulator's capabilities; however, basic programming knowledge and familiarity with the microcontroller architecture are assumed.

Chapter 2: Hardware Installation

MetaLink iceMASTER AD emulators are compact, modular assemblies. Each subassembly is detachable by use of a mating connector. For a complete description of all the hardware components of the emulator, see the Hardware Description (Chapter 3).

Installation

Connect the 50 pin flat cable to both the emulator base and the probe card. You should never turn the power to the emulator base on when the probe card is not connected. **Note that the emulator will not run without the probe card connected.**

Connect the RS-232 cable to the emulator base and to the Host Computer. Be sure you are using Communication Port 1 (COM1), 2 (COM2), 3 (COM3) or 4 (COM4).

Connect the power supply to the emulator by inserting the power supply's connector into the emulator power receptacle. For safety, we recommend that all items in your system, including emulator, Host Computer and target, be connected to the same outlet. Different outlets (even though near one another) may be connected to different circuits in the building, resulting in large potential differences between grounds.

Connect the optional probe clip assembly to the Probe Clip Header (on the probe card).

Warning: The emulator is not designed to be “hot-plugged”. The emulator base and target system must be turned off when attaching or removing the emulator from the target system. In addition, the emulator must be turned off when attaching or removing the probe card. “Hot-plugging” may cause CMOS latch-up and can void the warranty.

Chapter 3: Hardware Description

Emulator Chassis

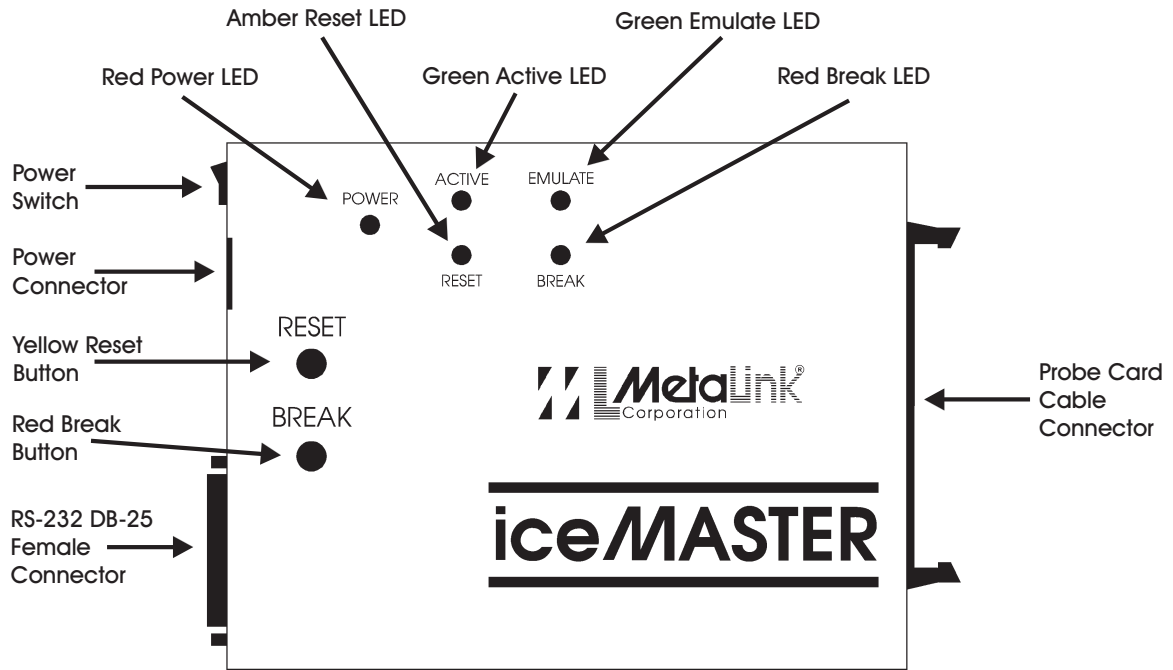


Figure 1. Emulator Chassis

Switches Three switches are provided on the emulator chassis, as follows:

- 1) The rocker switch on the left side-panel is for **Power**.
- 2) The push-button labeled **RESET**, on top of the emulator, allows you to reset the probe card. Unless there is an independent reset-out signal provided by the microcontroller, there is no reset provided by this switch for your target system. If you require such a target system reset, you must provide it. Reset inputs to the microcontroller are valid.
- 3) Activating the push-button labeled **BREAK**, puts the emulator into Break condition. That is, it halts execution of your code and places you in interactive mode in the Host Software.

LED Indicators Five labeled LED indicators provide you with visual feedback on the state of the emulator:

- 1) The red LED, labeled **POWER**, is lit when power is applied to the emulator.

- 2) The green LED, labeled **ACTIVE**, is lit to indicate that the emulation processor is running and will normally be ON unless a CMOS power-saving mode of operation is invoked. When the green **ACTIVE** light is ON it indicates that the microcontroller is active.
- 3) The amber LED, labeled **RESET**, is lit when Reset is active. The Reset and Active LEDs are mutually exclusive. Only one should be active (ON) at a time, but if one of the CMOS power-saving modes of operation is active it is normal for both LEDs to be OFF.
- 4) The red LED, labeled **BREAK**, will be ON when the emulator is in Break condition (interactive mode).
- 5) The green LED, labeled **EMULATE**, will be ON when the emulator is in Emulation condition (your code is running).

Power Connector

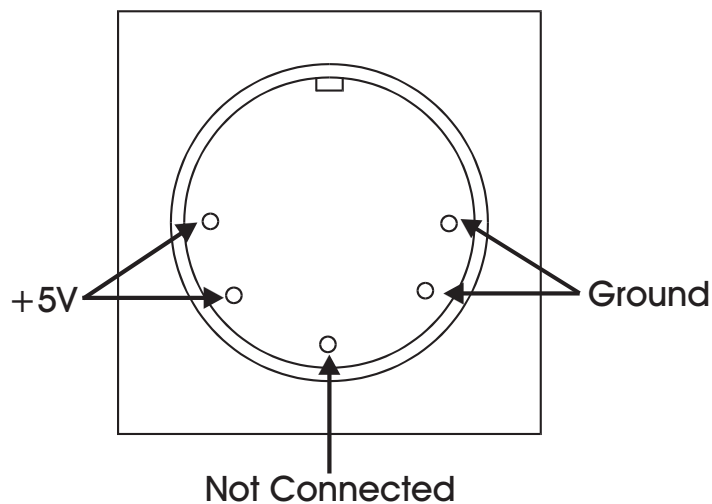


Figure 2. Power Connector (on emulator)

Power is supplied with a standard DIN audio connector similar to the keyboard connector found in many PC's. The power supply must provide +5 volts \pm 5%, at 1.5 amperes. The ripple voltage must be no greater than 50 millivolts, peak-to-peak.

Probe Pin Protection

It is advisable to use a high-quality socket at all times to protect the hardened machined pins of the probe card. The machined pins of the probe card are not easily replaced not are they covered under the MetaLink warranty.

RS-232 Interface

Host PC Cable Connector		Cable			Emulator Base Cable Connector (Male DB-25)	
Signal	Pin		Function	Direction	Pin	Signal
	PC/XT (Female DB-25)	PC/AT (Female DB-9)				
TxD	2	3	Data to ICE	→	2	RxD
RxD	3	2	Data to Host	←	3	TxD
RTS	4	7	Reset ICE - active low	→	4	RTS
CTS	5	8	ACTIVE to HOST	←	5	CTS
DSR	6	6	DSR to HOST	←	6	DSR
Ground	7	5	DC Ground	↔	7	Ground
DTR	20	4	Handshake	→	20	DTR

Table 1. RS-232 Interface

The communication link to the Host Computer is based on the serial RS-232-C specification. The serial baud rates are established entirely under software control. Therefore, you do not need to adjust your serial port's baud rate manually.

Probe Card Cable

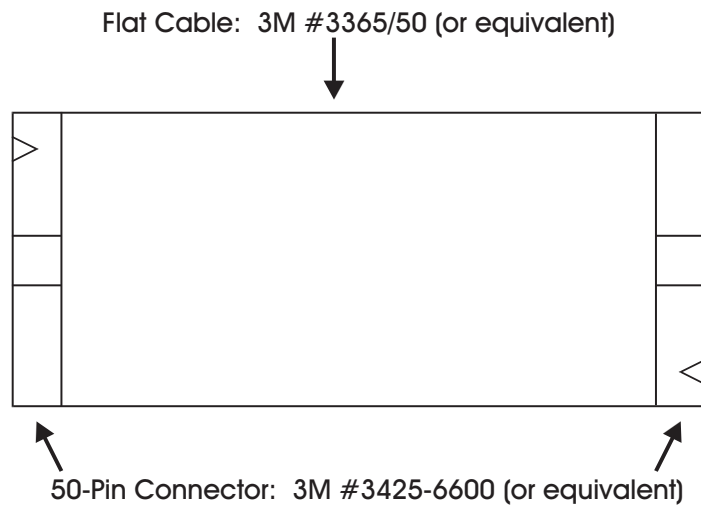


Figure 3. Probe Card Cable

On the probe card cable, IDC connectors mate with 50-pin ejector headers at either end for quick, easy assembly and disassembly of the emulator's primary parts. Note that the ribbon cable is keyed on both ends and is reversible.

Probe Clip Assembly (Optional)

The Probe Clip Assembly can be installed at your option. It is composed of seven input signal lines, four ground lines, one Trigger Output line, and one Break Input line. Note that there are two types of probe clip assemblies, depending on your probe card, as the following table shows.

Probe Clip Assemblies	
Schematic of Male Header on Probe Card	Orientation of Header and Silkscreened Labels as They Actually Appear on Probe Card
<p>A schematic diagram of a male header with 14 pins. The top row of pins is labeled G, G, G, 6, 4, 2, 0. The bottom row of pins is labeled B, T, G, NC, 5, 3, 1. There are four ground pins (G) and one break input pin (B).</p>	<p>A diagram showing the physical orientation of the header. The top row of pins is labeled 0 and 1. The bottom row of pins is labeled B, T, and CLIPS. There are four ground pins (G) and one break input pin (B).</p>
<p>A schematic diagram of a male header with 14 pins. The top row of pins is labeled 1, 3, 5, NC, G, T, B. The bottom row of pins is labeled 0, 2, 4, 6, G, G, G. There are four ground pins (G) and one break input pin (B).</p>	<p>A diagram showing the physical orientation of the header. The top row of pins is labeled CLIPS, T, B. The bottom row of pins is labeled 1 and 0. There are four ground pins (G) and one break input pin (B).</p>

Table 2. Probe Clip Assembly Schematic, Orientation

The following table of specifications applies to both types of probe clip assemblies.

Probe Clip Assembly Specifications			
Schematic Marking	Pin Function	Printed Label on Probe Card	Clip Color
0,1,2,3,4,5,6	Probe Clips	CLIPS	All Same Color (but not Green, Yellow or Black)
B	Break Input	B	Green
T	Trigger Output	T	Yellow
G	Ground		Black
NC	(Not Connected)		
14-Position Socket Connector:		3M 3385-6000 or equivalent	
14-Conductor Flat Cable:		Belden 9R28014 or equivalent (maximum length: 12 in./30 cm.)	
Test Clip (13 Pieces):		Pomona Test Type 4743 or equivalent	

Table 3. Probe Clip Assembly Specifications

The 14-pin female connector plugs in with the keying mark on the connector body-oriented to the silk-screened B at the corner of the male header on the probe card.

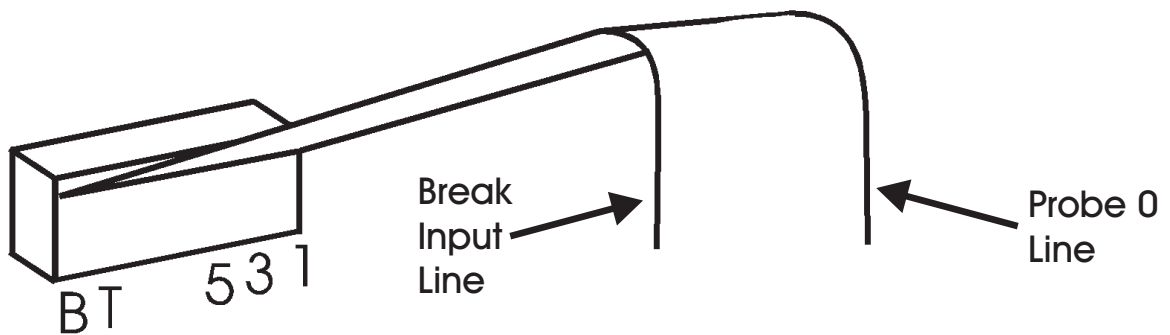


Figure 4. Probe Clip Assembly Diagram

Input Signal Lines (CLIPS)	There are seven user-selectable probe clip input signal lines which are inputs to a 74LS245 device on the probe card. These seven probe clip input signal lines can be used to select any TTL-level signal and record its state. The input signal lines are recorded in the middle of each bus cycle. These states are recorded in the trace buffer (see the Trace Window).
Probe clip 0 is oriented as shown.	
Break Input Signal (B)	The Break Input signal is interfaced via a 74ACT245 device on the probe card. The Break Input is pulled up with a 2K ohm pull-up resistor. When this input is pulled low, the emulation cycle will break. The Break Input must remain active (LOW) for at least one instruction cycle.
Trigger Output Signal (T)	The Trigger Output signal is interfaced via a 74ACT245 device on the probe card. The Trigger Output signal is normally HIGH and will strobe LOW (active) every time the Program Counter passes a Trace ON point (see <i>TRON</i> in the “Add Breakpoint” dialog box). The Trigger Output will remain active for a minimum of one instruction cycle (until the next Opcode Fetch). Thus, for an instruction which uses two or more instruction cycles to complete, the Trace ON signal will remain active for that time.

Chapter 4: Probe Card Reference

MetaLink emulator probe cards provide a number of user-selectable options via jumper blocks on the probe cards. The following pages depict each target probe card and show the relative location of each jumper block. The jumpers must be set in a valid configuration in order for the emulator to function correctly.

The following pages also contain mode information and mapping constraint information for each probe card.

COP8x0CJ, COP8640C, COP880C, COP884xx and COP888xx Probe Cards (Type A, B and C)

COP8 Type A, B and C Probe Card Determination

There are three types of probe cards used for these COP8 devices. The probe card type may be determined by the presence (or absence) of the W9 jumper block (upper left corner) and the VCC STATUS LED (left side) on the probe card. The following table shows how to determine which probe card you have. Note that these are not the only differences between the probe cards but are all that are needed to distinguish between them.

	Probe Card		
	Type A	Type B	Type C
VCC STATUS LED	√	√	–
W9 Jumper Block	√	–	–

Table 4. Type A, B and C Probe Card Determination

COP8x0CJ, COP8640C, COP880C, COP884xx and COP888xx Probe Cards (Type A)

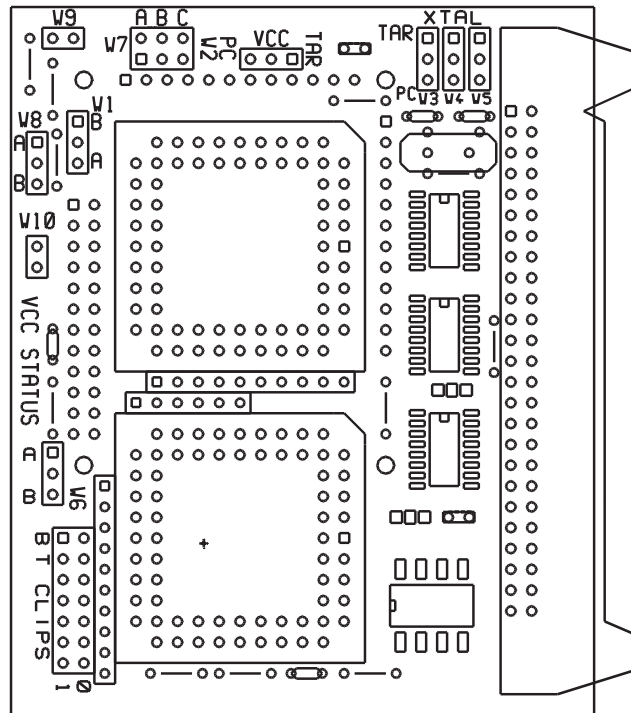


Figure 6. COP8x0CJ, COP8640C, COP880C, COP884xx and COP888xx Probe Cards (Type A)

Note

The Type A COP8 Probe Card can use two different emulation devices, either an “EMU” device or a “MOLE” device and although the probe cards appear to be the same they are factory configured for just one of the two devices. For this reason the Type A probe Card cannot be upgraded from one device type to the other. The differences between the two types are found in the W5, W7 and W8 jumpers.

LEDs

VCC STATUS

The VCC STATUS LED (D1) indicates that the probe card processor is being run from a voltage source that is less than the minimum operational voltage for the probe card. The nominal Brown Out voltage is 2.52 V_{CC} for all probe cards other than the COP820CJ and COP840CJ, with approximately 140 millivolts of hysteresis. This voltage level is due to the operating characteristics of the probe card and may differ from final production parts.

NOTE: V_{CC} Status (Brown Out) is a feature of the probe card (not the device) and is therefore available on all probe cards. Currently, the only production COP8 parts that incorporate Brown Out protection are the COP820CJ and COP840CJ.

Jumper Blocks

W1 The **W1** jumper controls the Internal RAM Size on COP880C probe cards and the HALT Enable Mask Option on COP884xx and COP888xx probe cards. The configuration of this jumper is readable by the host software and its setting can be verified in the Identification Window.

Internal RAM Available (COP880C only)

- A - 64 bytes of RAM available (emulate 820).
- B - 128 bytes of RAM available (emulate 840 and 880).

HALT Enable Mask Option (COP884xx and COP888xx only)

- A - HALT functionality disabled.
- B - HALT functionality enabled.

W2
VCC The **VCC** jumper (W2) is effective only on the 2.3V-6.0V and 2.5V-6.0V probe cards. This jumper allows the operating voltage of the probe card to be supplied from either the probe card (PC) or the target system (TAR). The PC setting supplies only 5.0V and is required for out-of-target emulation. The TAR setting uses the voltage supplied to the V_{CC} pin of the microcontroller socket on the target system. This voltage may range anywhere from 2.3V to 6.0V or 2.5VDC to 6.0VDC depending on your probe card.

On 4.5V-5.5V probe cards this jumper is hardwired to the PC setting. **THIS MUST NOT BE CHANGED! OPERATING A 4.5V-5.5V PROBE CARD OUTSIDE THIS VOLTAGE RANGE MAY PERMANENTLY DAMAGE THE PROBE CARD.**

When operating a 2.3V-6.0V or 2.5V-6.0V probe card with a voltage source less than 4V, the maximum operating frequency must be reduced per the National Semiconductor specification for the particular part. Attempting to operate the probe card above that maximum frequency will cause unpredictable results.

W3, W4, W5
XTAL The **XTAL** jumpers (W3, W4 and W5) allow the clock source (CKI) to be supplied from either the probe card (PC) or the target system (TAR). An oscillator circuit is used on the probe card to emulate the oscillator circuit of the microcontroller. When the PC setting is selected, a 10MHz crystal is connected to the oscillator circuit.

EMU Devices. The actual operating frequency of the microcontroller is determined by the W8 jumper block selection (below). The W3, W4 and W5 jumpers must all be set to the same position for proper operation. G7 is only available to the target system as a general-purpose input in the Clock Driver mode of operation (see W8 below).

Oscillator Source	W3	W4	W5
Probe Card	PC	PC	PC
Target	TAR	TAR	TAR

Table 5. XTAL Jumpers (EMU Devices)

MOLE Devices. W5 has no function and should be left open. When the PC setting is selected, G7 is still available to the target system as a general-purpose input. When the TAR setting is selected, either a target crystal or clock driver can be used.

Oscillator Source	W3	W4	W5
Probe Card	PC	PC	OPEN
Target	TAR	TAR	OPEN

Table 6. XTAL Jumpers (MOLE Devices)

**W6
VCC
STATUS**

The **VCC STATUS** jumper (W6) allows you to generate a hard reset to the microcontroller when V_{CC} drops below the nominal Brown Out voltage as specified in the previous section. True Brown Out protection is available only in the COP820CJ and COP840CJ; the V_{CC} monitoring feature is strictly an operational safety feature on all other probe cards.

VCC STATUS (all but COP820CJ and COP840CJ). When enabled, a low V_{CC} condition will hold the probe card in reset until the condition is corrected. When disabled, the reset feature is disabled.

- A - VCC STATUS monitoring disabled.
- B - VCC STATUS monitoring enabled.

NOTE: the VCC STATUS indicator (the yellow LED labeled D1 on the probe card) will always light when a voltage lower than the Brown Out voltage is detected, regardless of the state of the W6 jumper.

**W7
G7 Option**

The **G7 Option** jumper (W7) allows you to emulate the G7 bondout option of the target processor. When emulating CKO, the probe card oscillator is driven out the target G7 pin. When emulating the INPUT/HALT bond out option the target G7 pin is routed directly to the Probe card processors G7 pin.

EMU Device. When running with a target crystal W7 must be in the CKO (B + C) position.

G7 Option	W7
CKO	B + C
INPUT/HALT	A

Table 7. G7 Option Jumper (EMU Devices)

MOLE Device. When running with a target crystal W7 must be in the CKO (B) position. The C position must always be open

G7 Option	W7
CKO	B
INPUT/HALT	A

Table 8. G7 Option Jumper (MOLE Devices)

**W8
Clock Mode**

EMU Device. The **Clock Mode** jumper (W8) selects between an oscillator clock source and a clock driver source. The clock driver source mode can be used when emulating an RC mode of operation.

Position A selects the clock oscillator mode of operation. The crystal frequency is supplied directly to the COP microcontroller regardless of the XTAL source, probe card (PC) or target (TAR). When in this position, G7 is NOT available to the target and W7 jumper position C must be installed (see W7 jumper description).

Position B selects the clock driver mode of operation. In this position G7 is available to the target as a general purpose input (see W7 jumper description for proper setting). The clock is NOT supplied directly to the microcontroller but is determined by the source settings of W3, W4, and W5.

If the clock source is the Probe Card (W3, W4, and W5 set to PC) then a fixed frequency of 3.33 Mhz is supplied to the COP microcontroller.

If the clock source is the Target (W3, W4, and W5 set to TAR) then the clock of the COP microcontroller is supplied directly by the CKI pin on the target.

Note: the maximum input frequency in clock driver mode is 3.33 Mhz and should be a CMOS 50% duty cycle signal.

MOLE Device. The Clock Mode jumper (W8) has no function and should be left open.

**W9
G1 Pull-up** Placing a jumper on W9 connects a weak (47K) pull-up on G1 (WDOUT). This jumper is required for stand-alone operation and is optional when operating in a target.

**W10
G0
Pull-down** Placing a jumper on W10 connects a weak (47K) pull-down on G0 (INTR). This jumper is required for stand-alone operation and is optional when operating in a target.

Device Orientation DIP Package

COP8 probe cards are supplied with a probe head that has a DIP footprint connection for the target system. Pin one side orientation of the DIP can be determined by viewing the probe head from the cable header (component) side. Pin one is in the upper left corner of the device (toward the corner of the probe card where the W1 Jumper is located). Pin one is marked on the target adapter board.

Device Orientation PLCC Package

COP8 probe cards are supplied with a probe head that has a PLCC footprint connection for the target system. Pin one side orientation of the DIP can be determined by viewing the probe head from the cable header (component) side. Pin one is in the middle of the device (on the side toward the probe card cable header). Pin one is marked on the target adapter board.

COP8x0CJ, COP8640C, COP880C, COP884xx and COP888xx Probe Cards (Type B)

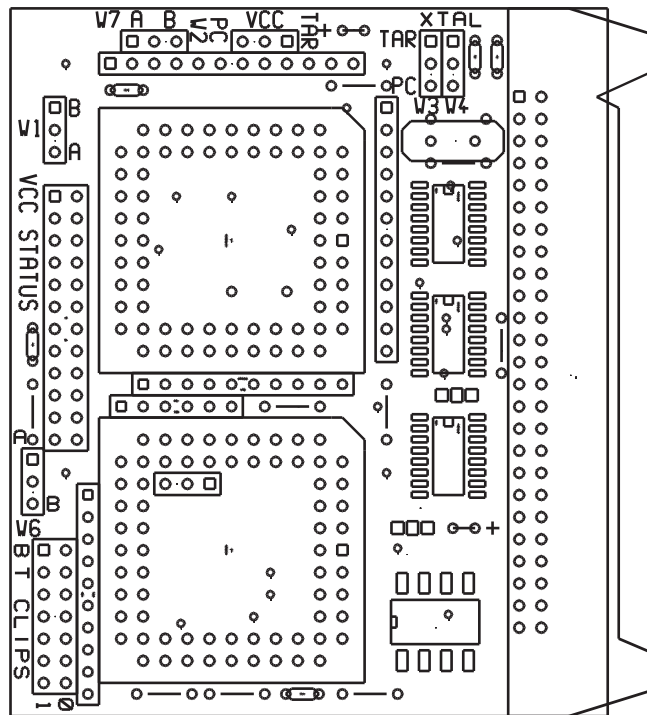


Figure 7. COP8x0CJ, COP8640C, COP880C, COP884xx and COP888xx Probe Cards (Type B)

LEDs

VCC STATUS

The VCC STATUS LED (D1) indicates that the probe card processor is being run from a voltage source that is less than the

- 1) (COP820CJ, COP840CJ) Brown Out voltage
- 2) (all others) minimum operational voltage

for the probe card. The nominal Brown Out voltage is 2.34 VDC for the COP820CJ and COP840CJ probe cards and 2.52 V_{CC} for all other probe cards, with approximately 140 millivolts of hysteresis. This voltage level is due to the operating characteristics of the probe card and may differ from final production parts.

NOTE: VCC STATUS is a feature of the probe card (not the device) and is therefore available on all probe cards. Currently, the only production COP8 parts that incorporate Brown Out protection are the COP820CJ and COP840CJ.

Jumper Blocks

W1 The **W1** jumper controls the Internal RAM Size on COP880C probe cards and the HALT Enable Mask Option on COP884xx and COP888xx probe cards. The configuration of this jumper is readable by the host software and its setting can be verified in the Identification Window. Note this jumper is not used on the COP8640C probe card.

Internal RAM Available (COP820CJ and COP880C only)

- A - 64 bytes of RAM available (emulate 820, 820CJ and 840CJ).
- B - 128 bytes of RAM available (emulate 840 and 880).

HALT Enable Mask Option (COP884xx and COP888xx only)

- A - HALT functionality disabled.
- B - HALT functionality enabled.

W2
VCC The **VCC** jumper (W2) is effective only on the 2.3V-6.0V and 2.5V-6.0V probe cards. This jumper allows the operating voltage of the probe card to be supplied from either the probe card (PC) or the target system (TAR). The PC setting supplies only 5.0V and is required for out-of-target emulation. The TAR setting uses the voltage supplied to the V_{CC} pin of the microcontroller socket on the target system. This voltage may range anywhere from 2.3V to 6.0V or 2.5VDC to 6.0VDC depending on your probe card.

On 4.5V-5.5V probe cards this jumper is hardwired to the PC setting. **THIS MUST NOT BE CHANGED! OPERATING A 4.5V-5.5V PROBE CARD OUTSIDE THIS VOLTAGE RANGE MAY PERMANENTLY DAMAGE THE PROBE CARD.**

When operating a 2.3V-6.0V or 2.5V-6.0V probe card with a voltage source less than 4V, the maximum operating frequency must be reduced per the National Semiconductor specification for the particular part. Attempting to operate the probe card above that maximum frequency will cause unpredictable results.

W3, W4
XTAL The **XTAL** jumpers (W3 and W4) allow the clock source (CKI) to be supplied from either the probe card (PC) or the target system (TAR). An oscillator circuit is used on the probe card to emulate the oscillator circuit of the microcontroller. When the PC setting is selected, a 10MHz crystal is connected to the oscillator circuit. With this

setting, G7 is still available to the target system as a general-purpose input. When the TAR setting is selected, either a target crystal or clock driver can be used.

Oscillator Source	W3	W4
Probe Card	PC	PC
Target	TAR	TAR

Table 9. XTAL Jumpers

**W6
VCC
STATUS**

The **VCC STATUS** jumper (W6) allows you to emulate the Brown Out bondout option on COP820CJ probe cards. For all other probe cards, this jumper enables the probe card to generate a hard reset to the microcontroller when V_{CC} drops below the nominal Brown Out voltage as specified in the previous section. True Brown Out protection is available only in the COP820CJ and COP840CJ; the V_{CC} monitoring feature is strictly an operational safety feature on all other probe cards.

COP820CJ and COP840CJ only. When enabled, the Brown Out feature will be emulated. When disabled, the Brown Out feature will NOT be emulated.

- A - BROWN OUT disabled.
- B - BROWN OUT enabled.

All But COP820CJ. When enabled, a low V_{CC} condition will hold the probe card in reset until the condition is corrected. When disabled, the reset feature is disabled.

- A - VCC STATUS monitoring disabled.
- B - VCC STATUS monitoring enabled.

NOTE: the VCC STATUS indicator (the yellow LED labelled D1 on the probe card) will always light when a voltage lower than the Brown Out voltage is detected, regardless of the state of the W6 jumper.

**W7
G7 Option**

The **G7 Option** jumper (W7) allows you to emulate the G7 bondout option of the target processor. When emulating CKO, the probe card oscillator is driven out the target G7 pin. When emulating the INPUT/HALT bond out option the target G7 pin is routed directly to the Probe card processors G7 pin. When running with a target crystal W7 must be in the CKO (B) position.

- A - INPUT/HALT selected.
- B - CKO selected.

Device Orientation DIP Package

COP8 probe cards are supplied with a probe head that has a DIP footprint connection for the target system. Pin one side orientation of the DIP can be determined by viewing the probe head from the cable header (component) side. Pin one is in the upper left corner of the device (toward the corner of the probe card where the W1 Jumper is located). Pin one is marked on the target adapter board.

Device Orientation PLCC Package

COP8 probe cards are supplied with a probe head that has a PLCC footprint connection for the target system. Pin one side orientation of the DIP can be determined by viewing the probe head from the cable header (component) side. Pin one is in the middle of the device (on the side toward the probe card cable header). Pin one is marked on the target adapter board.

COP8640C EEPROM Memory

Whenever the Host Software attempts to access (read or write) any location in the COP8640C EEPROM, it first reads the EECR register to determine whether or not the EEPROM is busy completing a previously initiated EEPROM write cycle. If the EEPROM is busy, the Host Software pops up a box with the following message:

“Waiting for ‘BsyERAM’ to clear before reading/writing location nnnn.”

The Host Software then continues checking the EECR register and does not attempt to read or write the byte until the EEPROM is no longer busy.

COP8x0CJ, COP8640C, COP880C, COP884xx and COP888xx Probe Cards (Type C)

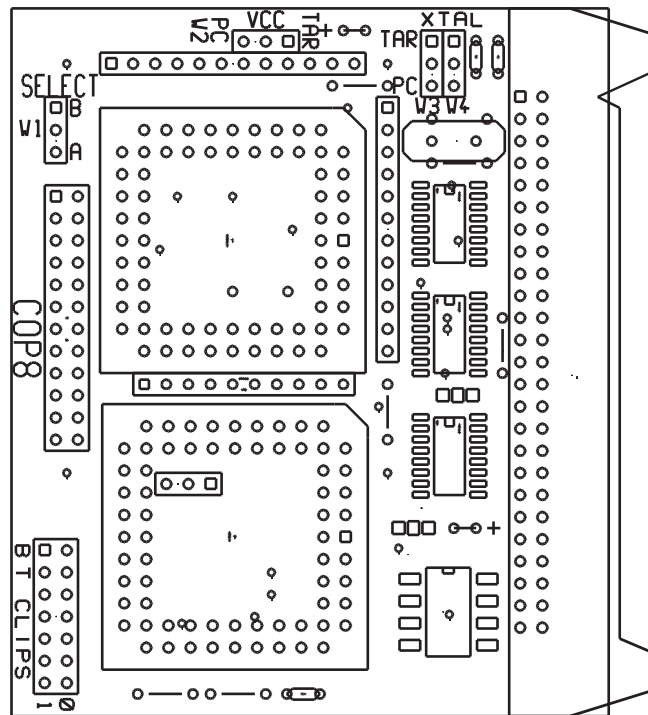


Figure 8. COP8x0CJ, COP8640C, COP880C, COP884xx and COP888xx Probe Cards (Type C)

Jumper Blocks

W1 The **W1** jumper controls the Internal RAM Size on COP880C probe cards and the HALT Enable Mask Option on COP884xx and COP888xx probe cards. The configuration of this jumper is readable by the host software and its setting can be verified in the Identification Window.

Internal RAM Available (COP880C only)

- A - 64 bytes of RAM available (emulate 820).
- B - 128 bytes of RAM available (emulate 840 and 880).

HALT Enable Mask Option (COP884xx and COP888xx only)

- A - HALT functionality disabled.
- B - HALT functionality enabled.

**W2
VCC**

The VCC jumper (W2) is effective only on the 2.3V-6.0V and 2.5V-6.0V probe cards. This jumper allows the operating voltage of the probe card to be supplied from either the probe card (PC) or the target system (TAR). The PC setting supplies only 5.0V and is required for out-of-target emulation. The TAR setting uses the voltage supplied to the V_{CC} pin of the microcontroller socket on the target system. This voltage may range between 2.3V to 6.0V or 2.5VDC to 6.0VDC depending on your probe card.

On 4.5V-5.5V probe cards this jumper is hardwired. **DO NOT CHANGE! OPERATING A 4.5V-5.5V PROBE CARD OUTSIDE THIS VOLTAGE RANGE MAY PERMANENTLY DAMAGE THE PROBE CARD.**

When operating a 2.3V-6.0V or 2.5V-6.0V probe card with a voltage source less than 4V, the maximum operating frequency must be reduced per the National Semiconductor specification for the particular part. Attempting to operate the probe card above that maximum frequency will cause unpredictable results.

**W3, W4
XTAL**

The XTAL jumpers (W3 and W4) allow the clock source (CKI) to be supplied from either the probe card (PC) or the target system (TAR). An oscillator circuit is used on the probe card to emulate the oscillator circuit of the microcontroller. When the PC setting is selected, a 10MHz crystal is connected to the oscillator circuit. With this setting, G7 is still available to the target system as a general-purpose input. When the TAR setting is selected, either a target crystal or clock driver can be used.

Oscillator Source	W3	W4
Probe Card	PC	PC
Target	TAR	TAR

Table 10. XTAL Jumpers

Device Orientation DIP Package

COP8 probe cards are supplied with a probe head that has a DIP footprint connection for the target system. Pin one side orientation of the DIP can be determined by viewing the probe head from the cable header (component) side. Pin one is in the upper left corner of the device (toward the corner of the probe card where the W1 Jumper is located). Pin one is marked on the target adapter board.

Device Orientation PLCC Package

COP8 probe cards are supplied with a probe head that has a PLCC footprint connection for the target system. Pin one side orientation of the DIP can be determined by viewing the probe head from the cable header (component) side. Pin one is in the middle of the device (on the side toward the cable header). Pin one is marked on the target adapter board.

COP8ACC Probe Card

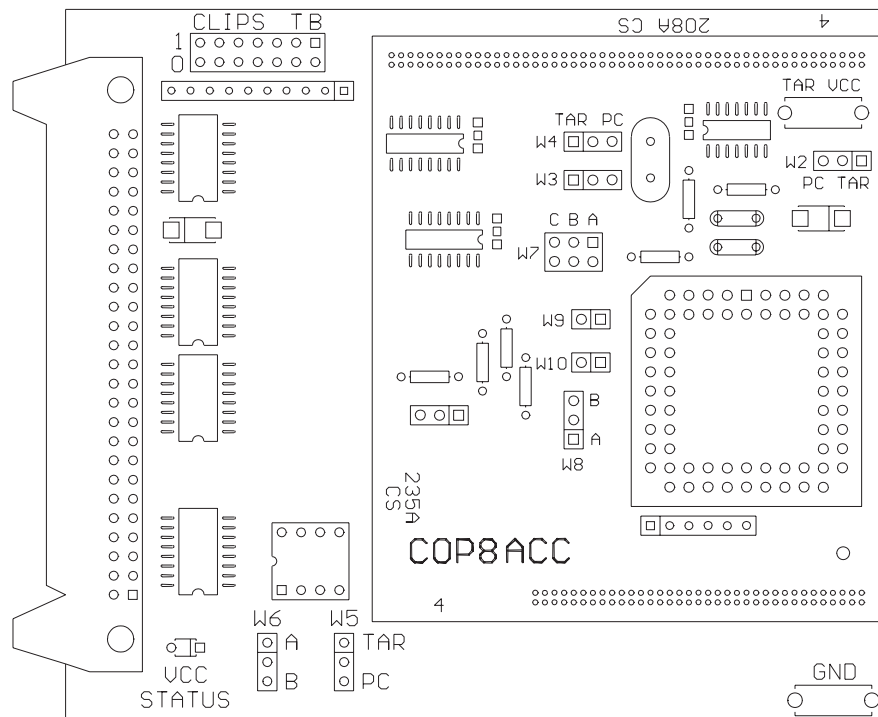


Figure 9. COP8ACC Probe Card

LEDs

VCC STATUS

The **VCC STATUS** LED (D1) indicates that the probe card processor is being run from a voltage source that is less than the minimum operational voltage for the probe card. The nominal Brown Out voltage is 2.52 V_{CC} for all probe cards other than the COP820CJ and COP840CJ, with approximately 140 millivolts of hysteresis. This voltage level is due to the operating characteristics of the probe card and may differ from final production parts.

NOTE: V_{CC} Status (Brown Out) is a feature of the probe card (not the device) and is therefore available on all probe cards. Currently, the only production COP8 parts that incorporate Brown Out protection are the COP820CJ and COP840CJ.

Jumper Blocks

W2 VCC

The **VCC** jumper (W2) allows the operating voltage of the probe card to be supplied from either the probe card (PC) or the target system (TAR). The PC setting supplies only 5.0V and is required for out-of-target emulation. The TAR setting uses the voltage supplied to the VCC pin of the microcontroller socket on the target system. This voltage may range from 2.5 VDC to 6.0 VDC.

When operating the probe card with a voltage source less than 4V, the maximum operating frequency must be reduced per the National Semiconductor specification for the particular part. Attempting to operate the probe card above that maximum frequency will cause unpredictable results.

**W3, W4
XTAL**

The **XTAL** jumpers (W3 and W4) allow the clock source (CKI) to be supplied from either the probe card (PC) or the target system (TAR). An oscillator circuit is used on the probe card to emulate the oscillator circuit of the microcontroller. When the PC setting is selected, a 10MHz crystal is connected to the oscillator circuit.

The actual operating frequency of the microcontroller is determined by the W8 jumper block selection (below). Jumpers W3 and W4 must be set to the same position for proper operation. G7 is only available to the target system as a general-purpose input in the Clock Driver mode of operation (see W8 below).

Oscillator Source	W3	W4
Probe Card	PC	PC
Target	TAR	TAR

Table 11. XTAL Jumpers

**W6
VCC
STATUS**

The **VCC STATUS** jumper (W6) allows you to generate a hard reset to the microcontroller when V_{CC} drops below the nominal Brown Out voltage as specified in the previous section. True Brown Out protection is available only in the COP820CJ; the VCC Status monitoring feature is strictly an operational safety feature on other probe cards.

When enabled, a low V_{CC} condition will hold the probe card in reset until the condition is corrected. When disabled, the reset feature is disabled.

- A - VCC Status Disabled
- B - VCC Status Enabled

NOTE: the VCC STATUS indicator (the yellow LED labelled D1 on the probe card) will always light when a voltage lower than the Brown Out voltage is detected, regardless of the state of the W6 jumper.

**W7
G7 Option**

The **G7 Option** jumper (W7) allows you to emulate the G7 bondout option of the target processor. When emulating CKO, the probe card oscillator is driven out the target G7 pin. When emulating the INPUT/HALT bond out option the target G7 pin is routed directly to the Probe card processors G7 pin.

When running with a target crystal W7 must be in the CKO (B + C) position.

G7 Option	W7
CKO	B + C
INPUT/HALT	A

Table 12. G7 Option Jumper

**W8
Clock Mode** The **W8 Jumper** jumper selects between an oscillator clock source and a clock driver source. The clock driver source mode can be used when emulating an RC mode of operation.

Position A selects the clock oscillator mode of operation. The crystal frequency is supplied directly to the COP microcontroller regardless of the XTAL source, probe card (PC) or target (TAR). When in this position, G7 is NOT available to the target and W7 jumper position C must be installed (see W7 jumper description).

Position B selects the clock driver mode of operation. In this position G7 is available to the target as a general purpose input (see W7 jumper description for proper setting). The clock is NOT supplied directly to the microcontroller but is determined by the source settings of W3 and W4.

If the clock source is the Probe Card (W3, W4 set to PC) then a fixed frequency of 3.33 Mhz is supplied to the COP microcontroller. If the clock source is the Target (W3, W4 set to TAR) then the clock of the COP microcontroller is supplied directly by the CKI pin on the target.

Note: the maximum input frequency in clock driver mode is 3.33 Mhz and should be a CMOS 50% duty cycle signal.

**W9
G1 Pull-up** Placing a jumper on W9 connects a weak (47K) pull-up on G1 (WDOOUT). This jumper is required for stand-alone operation and is optional when operating in a target.

**W10
G0
Pull-down** Placing a jumper on W10 connects a weak (47K) pull-down on G0 (INTR). This jumper is required for stand-alone operation and is optional when operating in a target.

Device Orientation DIP Package

COP8 probe cards are supplied with a probe head that has a DIP footprint connection for the target system. Pin one side orientation of the DIP can be determined by viewing the probe head from the cable header (component) side. Pin one is in the upper left corner of the de-

vice (toward the corner of the probe card where the W2 Jumper is located). Pin one is marked on the target adapter board.

COP8Sax Probe Card

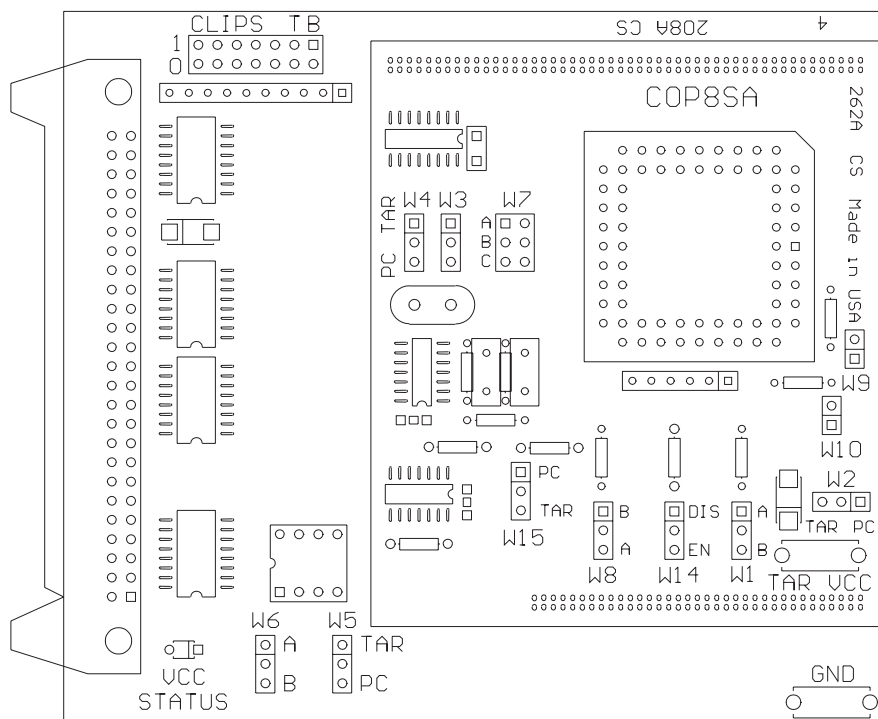


Figure 10. COP8SAX Probe Card

LEDs

VCC STATUS

The **VCC STATUS** LED (D1) indicates that the probe card processor is being run from a voltage source that is less than the minimum operational voltage for the probe card. The nominal Brown Out voltage is 2.52 V_{CC} for all probe cards other than the COP820CJ and COP840CJ, with approximately 140 millivolts of hysteresis. This voltage level is due to the operating characteristics of the probe card and may differ from final production parts.

NOTE: V_{CC} Status (Brown Out) is a feature of the probe card (not the device) and is therefore available on all probe cards. Currently, the only production COP8 parts that incorporate Brown Out protection are the COP820CJ and COP840CJ.

Jumper Blocks

W1 Internal RAM

The **Internal RAM** jumper (W1) determines the amount of Internal RAM available in the emulation microcontroller.

- A - 64 bytes of RAM (COP8SAA)
- B - 128 bytes of RAM (COP8SAB, COP8SAC)

**W2
VCC**

The **VCC** jumper (W2) allows the operating voltage of the probe card to be supplied from either the probe card (PC) or the target system (TAR). The PC setting supplies only 5.0V and is required for out-of-target emulation. The TAR setting uses the voltage supplied to the VCC pin of the microcontroller socket on the target system. This voltage may range from 2.5 VDC to 6.0 VDC.

When operating the probe card with a voltage source less than 4V, the maximum operating frequency must be reduced per the National Semiconductor specification for the particular part. Attempting to operate the probe card above that maximum frequency will cause unpredictable results.

**W3, W4,
W15
XTAL**

The **XTAL** jumpers (W3, W4 and W15) allow the clock source (CKI) to be supplied from either the probe card (PC) or the target system (TAR). An oscillator circuit is used on the probe card to emulate the oscillator circuit of the microcontroller. When the PC setting is selected, a 10MHz crystal is connected to the oscillator circuit.

The actual operating frequency of the microcontroller is determined by the W8 jumper block selection (below). Jumpers W3, W4 and W15 must be set to the same position for proper operation. G7 is only available to the target system as a general-purpose input in the Clock Driver mode of operation (see W8 below).

Oscillator Source	W3	W4	W15
Probe Card	PC	PC	PC
Target	TAR	TAR	TAR

Table 13. XTAL Jumpers

**W5
(Not Used)**

The **W5** jumper is not used for this probe card.

**W6
VCC
STATUS**

The **VCC STATUS** jumper (W6) allows you to generate a hard reset to the microcontroller when V_{CC} drops below the nominal Brown Out voltage as specified in the previous section. True Brown Out protection is available only in the COP820CJ and COP840CJ; the V_{CC} Status monitoring feature is strictly an operational safety feature on all other probe cards.

When enabled, a low V_{CC} condition will hold the probe card in reset until the condition is corrected. When disabled, the reset feature is disabled.

- A - VCC Status monitoring disabled.
- B - VCC Status monitoring enabled.

Note that the VCC STATUS indicator (the yellow LED on the probe card) will always light when a voltage lower than the Brown Out voltage is detected, regardless of the state of the W6 jumper.

**W7
G7 Option**

The **G7 Option** jumper (W7) allows you to emulate the G7 bondout option of the target processor. When emulating CKO, the probe card oscillator is driven out the target G7 pin. When emulating the INPUT/HALT bond out option the target G7 pin is routed directly to the Probe card processors G7 pin. When running with a target crystal W7 must be in the CKO (B + C) position.

G7 Option	W7
CKO	B + C
INPUT/HALT	A

Table 14. G7 Option Jumper

**W8
Clock Mode**

The **Clock Mode** jumper (W8) selects between an oscillator clock source and a clock driver source. The clock driver source mode can be used when emulating an RC mode of operation.

Position A selects the clock oscillator mode of operation. The crystal frequency is supplied directly to the COP microcontroller regardless of the XTAL source, probe card (PC) or target (TAR). When in this position, G7 is NOT available to the target and W7 jumper position C must be installed (see W7 jumper description).

Position B selects the clock driver mode of operation. In this position G7 is available to the target as a general purpose input (see W7 jumper description for proper setting). The clock is NOT supplied directly to the microcontroller but is determined by the source settings of W3, W4 and W15.

If the clock source is the Probe Card (W3, W4 and W15 set to PC) then a fixed frequency of 5 Mhz is supplied to the COP microcontroller. If the clock source is the Target (W3, W4 and W15 set to TAR) then the clock of the COP microcontroller is supplied directly by the CKI pin on the target.

Note: the maximum input frequency in clock driver mode is 5 Mhz and should be a CMOS 50% duty cycle signal.

**W9
G1 Pull-up**

Placing a jumper on W9 connects a weak (47K) pull-up on G1 (WDOUT). This jumper is required for stand-alone operation and is optional when operating in a target.

**W10
G0
Pull-down**

Placing a jumper on W10 connects a weak (47K) pull-down on G0 (INTR). This jumper is required for stand-alone operation and is optional when operating in a target.

- W14 Watchdog Timer** The **Watchdog Timer** jumper (W14) allows you to emulate the Watchdog option of the microcontroller.
- EN - Enable Watchdog option.
 - DIS - Disable Watchdog option.

Device Orientation

COP8 probe cards are supplied with a probe head that has either a DIP footprint or a PLCC footprint connection for the target system. Pin one is clearly marked on the target adapter board.

COP8SGR Probe Card

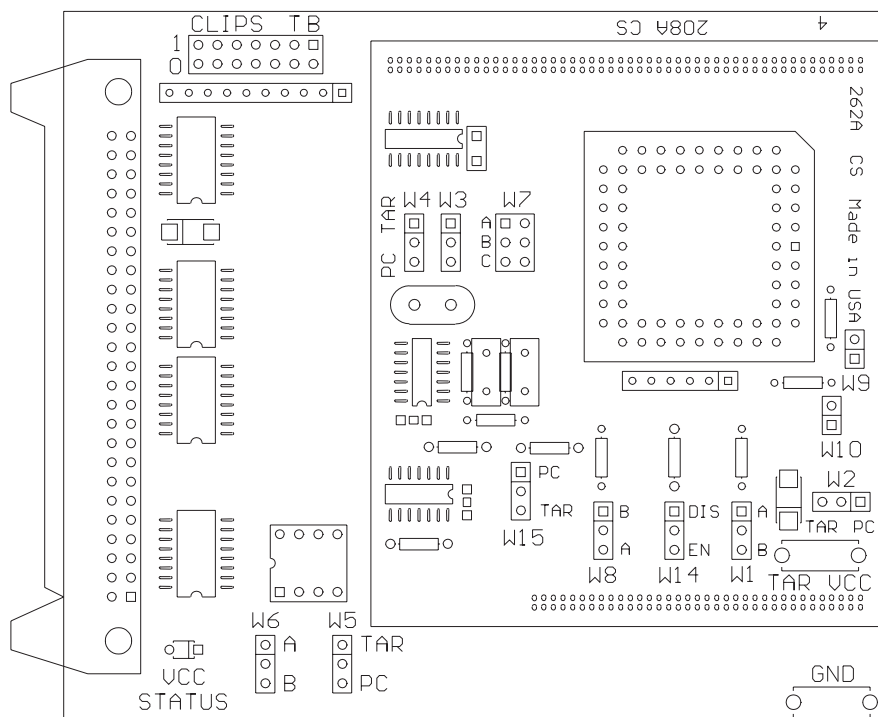


Figure 11. COP8SGR Probe Card

LEDs

VCC STATUS

The **VCC STATUS** LED (D1) indicates that the probe card processor is being run from a voltage source that is less than the minimum operational voltage for the probe card. The nominal Brown Out voltage is $2.52 V_{CC}$ for all probe cards other than the COP820CJ and COP840CJ, with approximately 140 millivolts of hysteresis. This voltage level is due to the operating characteristics of the probe card and may differ from final production parts.

NOTE: V_{CC} Status (Brown Out) is a feature of the probe card (not the device) and is therefore available on all probe cards. Currently, the only production COP8 parts that incorporate Brown Out protection are the COP820CJ and COP840CJ.

Jumper Blocks

W1 HALT Enable

The **HALT Enable** jumper (W1) controls the HALT enable mask option of the microcontroller.

- A - HALT disabled.
- B - HALT enabled.

**W2
VCC**

The **VCC** jumper (W2) allows the operating voltage of the probe card to be supplied from either the probe card (PC) or the target system (TAR). The PC setting supplies only 5.0V and is required for out-of-target emulation. The TAR setting uses the voltage supplied to the VCC pin of the microcontroller socket on the target system. This voltage may range from 2.5 VDC to 6.0 VDC.

When operating the probe card with a voltage source less than 4V, the maximum operating frequency must be reduced per the National Semiconductor specification for the particular part. Attempting to operate the probe card above that maximum frequency will cause unpredictable results.

**W3, W4,
W15
XTAL**

The **XTAL** jumpers (W3, W4 and W15) allow the clock source (CKI) to be supplied from either the probe card (PC) or the target system (TAR). An oscillator circuit is used on the probe card to emulate the oscillator circuit of the microcontroller. When the PC setting is selected, a 10MHz crystal is connected to the oscillator circuit.

The actual operating frequency of the microcontroller is determined by the W8 jumper block selection (below). Jumpers W3, W4 and W15 must be set to the same position for proper operation. G7 is only available to the target system as a general-purpose input in the Clock Driver mode of operation (see W8 below).

Oscillator Source	W3	W4	W15
Probe Card	PC	PC	PC
Target	TAR	TAR	TAR

Table 15. XTAL Jumpers

**W5
(Not Used)**

The **W5** jumper is not used for this probe card.

**W6
VCC
STATUS**

The **VCC STATUS** jumper (W6) allows you to generate a hard reset to the microcontroller when V_{CC} drops below the nominal Brown Out voltage as specified in the previous section. True Brown Out protection is available only in the COP820CJ and COP840CJ; the V_{CC} Status monitoring feature is strictly an operational safety feature on all other probe cards.

When enabled, a low V_{CC} condition will hold the probe card in reset until the condition is corrected. When disabled, the reset feature is disabled.

- A - VCC Status monitoring disabled.
- B - VCC Status monitoring enabled.

Note that the VCC STATUS indicator (the yellow LED on the probe card) will always light when a voltage lower than the Brown Out voltage is detected, regardless of the state of the W6 jumper.

**W7
G7 Option**

The **G7 Option** jumper (W7) allows you to emulate the G7 bondout option of the target processor. When emulating CKO, the probe card oscillator is driven out the target G7 pin. When emulating the INPUT/HALT bond out option the target G7 pin is routed directly to the Probe card processors G7 pin. When running with a target crystal W7 must be in the CKO (B + C) position.

G7 Option	W7
CKO	B + C
INPUT/HALT	A

Table 16. G7 Option Jumper

**W8
Clock Mode**

The **Clock Mode** jumper (W8) selects between an oscillator clock source and a clock driver source. The clock driver source mode can be used when emulating an RC mode of operation.

Position A selects the clock oscillator mode of operation. The crystal frequency is supplied directly to the COP microcontroller regardless of the XTAL source, probe card (PC) or target (TAR). When in this position, G7 is NOT available to the target and W7 jumper position C must be installed (see W7 jumper description).

Position B selects the clock driver mode of operation. In this position G7 is available to the target as a general purpose input (see W7 jumper description for proper setting). The clock is NOT supplied directly to the microcontroller but is determined by the source settings of W3, W4 and W15.

If the clock source is the Probe Card (W3, W4 and W15 set to PC) then a fixed frequency of 5 Mhz is supplied to the COP microcontroller. If the clock source is the Target (W3, W4 and W15 set to TAR) then the clock of the COP microcontroller is supplied directly by the CKI pin on the target.

Note: the maximum input frequency in clock driver mode is 5 Mhz and should be a CMOS 50% duty cycle signal.

**W9
G1 Pull-up**

Placing a jumper on W9 connects a weak (47K) pull-up on G1 (WDOUT). This jumper is required for stand-alone operation and is optional when operating in a target.

W10 Placing a jumper on W10 connects a weak (47K) pull-down on G0 (INTR). This
G0 jumper is required for stand-alone operation and is optional when operating in a tar-
Pull-down get.

W14 The **Watchdog Timer** jumper (W14) allows you to emulate the Watchdog option of
Watchdog the microcontroller.
Timer

- EN - Enable Watchdog option.
- DIS - Disable Watchdog option.

Device Orientation

COP8 probe cards are supplied with a probe head that has either a DIP footprint or a PLCC footprint connection for the target system. Pin one is clearly marked on the target adapter board.

Jumper Blocks

- W5
(Not Used)** The **W5** jumper is not used for this probe card.
- W6
(Not Used)** The **W6** jumper is not used for this probe card.
- W9
G1 PULLUP** • **PC** - if jumper is installed, a 47K pullup resistor is connected to G1 (WDOOUT). This jumper is required for standalone operation and is optional when operating in a target system.
- W10
G0
PULLDOWN** • **PC** - if jumper is installed, a 47K pulldown resistor is connected to GO (INTR). This jumper is required for standalone operation and is optional when operating in a target system.
- W3, W4,
W15, W24,
W25
FCLK XTAL** • **PC** - selects the on board 10 MHz crystal. Note that clock generated on-board Probe Card is present at target pins.
• **TAR** - selects the crystal in the target system or the crystal installed in J41 (on board FCLK “target” crystal).
- W16, W17,
W26
FCLK MODE** • **XTAL** - If FCLK XTAL jumpers are set for PC, a 10 MHz signal is fed differentially to CKI and CKO(G7). If FCLK XTAL jumpers are set for TAR, a target crystal must be attached to the target pins CKI & CKO (G7) or a crystal must be installed in J41. In this mode G7 is NOT available as an input pin OR to take the emulator out of HALT mode.
• **External** - External mode is NOT supported by the LMC6990 probe card. Placing the jumpers in this position may cause the emulator to lose communication with the PC.
- W18, W19
SCLK XTAL** • **PC** - selects the on board 32 KHz crystal
• **TAR** - selects the crystal in the target system or the crystal installed in J23 (on-board SCLK “target” crystal)
- W20
SCLK MODE** • **EXT** - Selects the external oscillator mode. If SCLK XTAL jumpers are set for PC, the onboard 32Khz crystal is attached to the bondout. If SCLK XTAL jumpers are set for TAR, a target crystal must be attached to target pins CKIS & CKOS or a crystal must be installed in J23.
• **INT** - Selects the internal oscillator mode. A precision resistor must be attached to CKOS. This can be done by attaching an external resistor to target pin CKOS or the internal resistor may be selected (see SCLK RES below).

**W21, W27
SCLK RES**

- **EXT** - If the SCLK MODE jumper is set to EXT this jumper has no function. If the SCLK MODE jumper is set to INT, a 1% 200K ohm resistor must be attached to the target CKOS pin.
- **INT** - If the SCLK MODE jumper is set to EXT this jumper has no function. If the SCLK MODE jumper is set to INT, an internal resistor is attached to the emulation processors CKOS pin.

**AVCC,
VREG1,
VREG2**

The AVCC, VREG1 and VREG2 jumpers control power to the emulation processor on the probe card. Note that all three jumpers must be set to the same setting.

- **PC** - 3.3 V is supplied from the probe card to power the emulation processor.
- **TAR HI** - An external FET must be attached to target pins VCC and VREG that will regulate an external 7 V - 20 V supply.

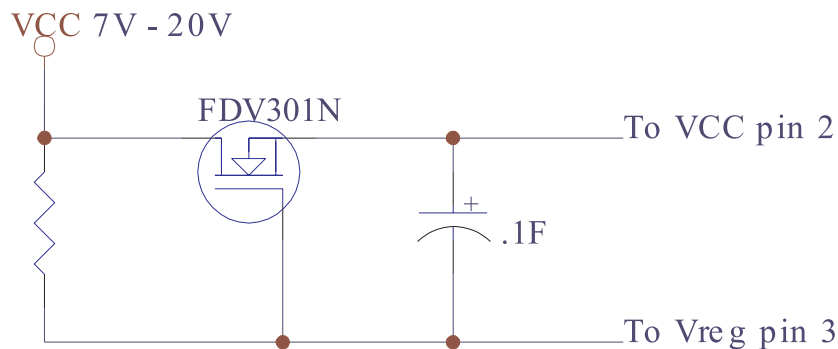


Figure 14. Target VCC and VREG Circuit Schematic

- **TAR LO** - A 4 V - 10 V supply must be connected to target pin VREG, the output of the emulation processor's internal 3.3 V regulator is seen on the target's VCC pin.

HALT

- **EN** - Halt mode is enabled.
- **DIS** - Halt mode is disabled.

WATCHDOG

- **EN** - The watchdog timer is enabled.
- **DIS** - The watchdog timer is disabled.

VB+

- **PC** - The VB+ pin is attached to a voltage divider circuit on the probe card (see VB+ V DIV circuit schematic on page). If no resistor is installed in the "VB+ V DIV" socket, 1 V will be present on the VB+ pin. A resistor can be installed in the "VB+ V DIV" socket to lower the voltage.
- **TAR** - The bondout's VB+ pin is connected to the target VB+ pin. Note that the target pin must not be allowed to float; it should be attached to 0 to 1 V.

IB+, IB-

- **PC** - The IB+ and IB- pins are attached to an on board sense resistor. The voltage across this resistor is determined by the IB+/- V DIV voltage divider jumpers (W33 and W34).

- **TAR** - The IB+/- pins are attached to the target IB+/- pins.

W33, W34 If the IB+ and IB- jumpers are set to PC, then the voltage across the on board sense resistor is determined as follows:
IB+/- V DIV

W33	W34	V(Rsense)	Current
Open	Open	0 V	0
Open	Shorted	68 mV	34% FS
Shorted	Open	128 mV	64% FS
Shorted	Shorted	180 mV	90% FS

Table 17. IB+/- V DIV Voltage Levels

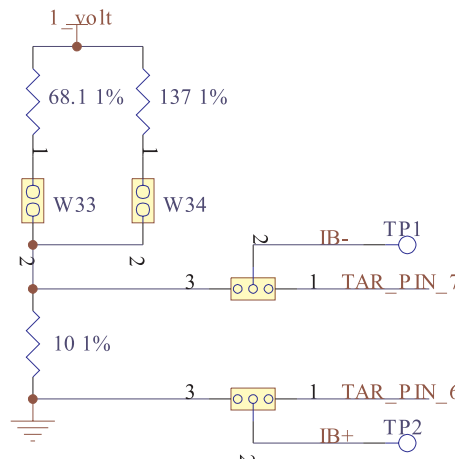


Figure 15. IB+/- V DIV Circuit Schematic

Vb0, Vb1, Vb2, Vb3:

- **PC** - If B[0..3] are set by user software to be Vb[0..3] and the emulator is operating in standalone mode, a variable voltage from .1 V to 1 V will be present on the Vb[0..3] pins depending on how the Vb[0..3] V DIV jumpers are set.

- **TAR** - B[0..3] pins are connected to the target B[0..3] pins.

W29, W30,
W31, W32
Vb[0..3]
V DIV

When the Vb[0..3] jumpers are set to PC, the voltage applied to these pins will be determined by the following chart:

W29	W30	W31	W32	V @ Vb[0..3]
Shorted	Open	Open	Open	.980 V
Open	Shorted	Open	Open	.768 V
Open	Open	Shorted	Open	.306 V
Open	Open	Open	Shorted	.100 V
Shorted	Shorted	Shorted	Shorted	.084 V

Table 18. Vb[0..3] Voltage Levels

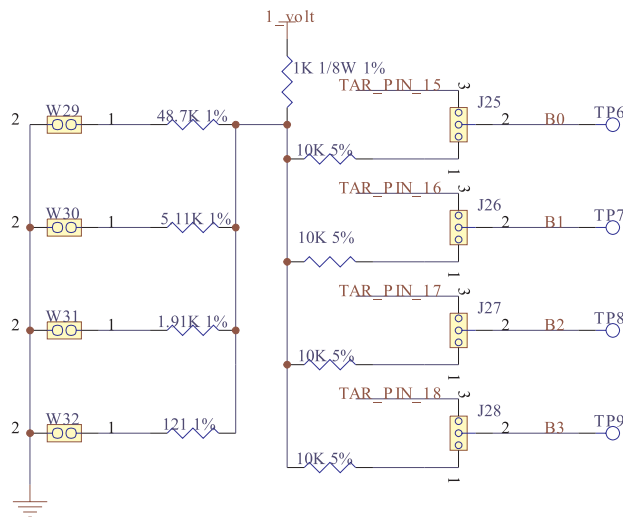


Figure 16. Vb[0..3] Jumper Circuit Schematic

AGND

- **PC** - The bondout's analog ground will be attached to the probe card's ground plane.
- **TP12** - The bondout's analog ground will be attached to TP12. You must supply a ground at the test point.

Chapter 5: Software Guide

Overview/Features

This chapter is an overview of some of the features of the software and a guide to help you understand the layout of the screen. Note that context sensitive help is available for every command.

Windows You can have any number of windows of any type, including multiple windows of the same type, open at the same time.

All windows are updated after an emulation cycle or after something changes (e.g., after you explicitly change the value in a register or memory location during Break Condition).

To cycle through the existing windows:

CTRL+F6: cycle forward
CTRL+SHIFT_F6: cycle backward

This is the Microsoft Windows convention for cycling through MDI (Multi-Document Interface) child windows.

The software implementation “model” most closely resembles an MDI application, with the following enhancements:

- 1) The “child” windows (all windows except the Main Window) are not constrained to be within (“be clipped by”) the Main Window. They can be anywhere on the screen. (For comparison: Open several documents in a word processor and move the document windows around.)
- 2) You can have as many “child” windows as you want, of a given type, open at the same time (e.g., 5 Code Memory windows, each viewing the same/different/overlapping memory addresses).
- 3) If you turn off the ‘Configure|Preferences|Move Windows with Main’ option, the Main Window can be moved independently of any “child” windows. Currently, re-sizing the Main Window is always done independently of any “child” windows.

Additionally, the Main Menu window will never be “on top of” any of the “child” windows.

You can also pick a specific existing window by selecting it from the bottom of the “Windows” pull-down menu.

Double Click

In general, double-click (left mouse button) on a symbol name, register name or memory-location to pop-up the “Display/Alter|Expression” dialog box, which will allow you to view, change or browse the value.

NOTE: Currently, right-clicking in a Browse Window (browse data structure) does pop-up a properties menu showing everything you can do to the selected item (e.g., change (modify), or browse further (if it is a pointer, structure or array)).

Save Settings On Exit

Currently, the “Save Settings on Exit” function saves the following values:

System-wide settings:

‘Configure|Preferences|Move Windows with Main’ setting.

‘Configure|Preferences|Input Options...’ settings:

Translation

Radix (2,8,10,16)

‘Configure|Preferences|Display Options...’ settings:

Annotate Source

Highlight Changed Values

Stack Browse Windows

Short Struct/Union Indentation

Show Struct/Union Member Names

Show Array Subscript Values

Unknown Data Type Size (1,2,3,4)

‘Configure|Preferences|Display Formats...’ settings:

unknown/untyped

short/ushort

int/uint

long/ulong

float

double

‘Configure|Preferences|Source Path’ setting.

‘Configure|Preferences|Move All Windows with Main’ setting.

‘Configure|Preferences|HLL Step by Instruction’ setting.

‘Configure|Preferences|Toolbar’ setting.

‘Configure|Break/Trace/Map Mode’ value (if applicable).

‘Run|Repetition Counter’ value.

‘Break/Trace|Trace Trigger’ setting and value.

‘Break/Trace|Counters’ value (Break counter and/or Pass counter).

‘Break/Trace|Mode’ value (if applicable).

‘File|Load’ program name. If there is one, we give you the option of reloading it or not when restarting the software.

For the Source Window(s):

‘View|Code/Mixed/HLL’ display mode setting.

‘View|Label Synch’ display mode setting.

‘Options|Track PC’ setting.

For each window:

Current position (x,y,z), size, font, vertical scrolling position, horizontal scrolling position, ‘Options|Scroll Immediate’ value.

These settings can optionally be restored (reestablished) whenever you restart the software, or you can select the default window configuration each time you restart the software.

**Host
Break**

There are several ways to stop emulation if no breakpoint is set or reached during emulation:

- 1) Click on the ‘Stop’ toolbar button.
- 2) Select the ‘Stop(Esc)’ command in the ‘Emulating’ window, if it is present.
- 3) Select the ‘Run|Stop’ command from the Main Menu window.
- 4) Press the ‘Esc’ key.

**Automatic
Configuration**

If the emulator is powered up when the software is invoked, communication between the emulator and the software will be established automatically.

Help

Detailed and context sensitive **Help** is available on-line using the Help Key (F1).

**Dynamically
Annotated
Code**

When emulating using single steps (*Step* command) or slow motion mode (*Slow Motion* command), the right side of the Source Window is used to display a history of execution for each instruction executed. This history contains the value (before execution of the instruction) of any address, register and Bit used by the instruction. In addition, if the instruction is an unconditional jump instruction or a conditional jump, where the condition is met (TRUE), the Target Address and an arrow indicat-

ing direction of program flow will be displayed. If the instruction is a conditional jump, where the condition is not met (FALSE), a * is displayed.

Default Screen Layout

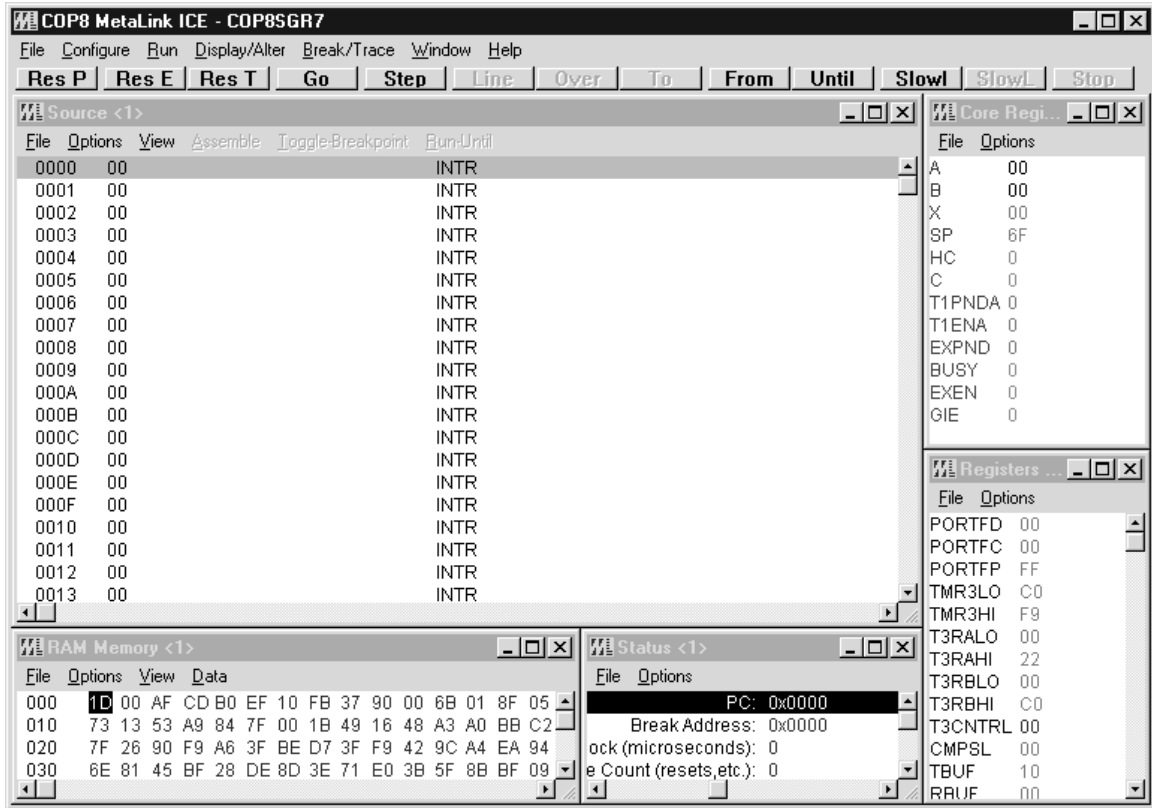


Figure 17. Default Screen Layout

The figure above shows the default screen layout. The windows shown (Source, RAM Memory, Core Registers, Registers (SFR), and Status) are just a subset of the available windows. The available windows are described below.

Available Windows

- Break** The Break Window is used to display, add, remove or edit break-points. Break-points are evaluated and transmitted to the emulator as they are created or edited.
- Browse** The Browse Window is used to inspect or change structures, unions, arrays, pointers and bit-fields. For each element of the object being browsed, at least the address, data type and value are displayed and where meaningful, array subscript values and member names are also displayed.

Code Memory	The Code Memory Window displays code memory as hexadecimal bytes and their ASCII equivalent. In addition, from the Code Memory Window you may fill or copy blocks of memory, compare two blocks of memory and search memory for a value (or values) match/mismatch.
Core Register	The Core Register Window is used to display the core architecture registers and bit flags.
Emulating	The Emulating Window is displayed when an emulation is started using any run-type commands. It displays status information about the current emulation cycle.
Identification	The Identification Window describes the properties of your emulator system. The information displayed includes such things as hardware, firmware and software versions numbers, memory sizes, model numbers and option configurations. Such information is useful, for example, when you call for technical support.
Program Structure	The Program Structure Window displays module, source line number or source scope information for the loaded program, if available.
RAM Memory	The RAM Window displays indirectly addressable RAM memory as hexadecimal bytes and their ASCII equivalent. In addition, from the RAM memory Window you may fill or copy blocks of memory, compare two blocks of memory and search memory for a value (or values) match/mismatch.
Register (SFR)	The Register (SFR) Window is used to display the special function registers (SFRs).
Source	The Source Window is used to display code memory as assembly level instructions, optionally with HLL source images, if available.
Stack	The Stack Window displays memory at the stack as hexadecimal bytes and their ASCII equivalent. In addition, from the Stack Window you may fill or move blocks of memory, compare two blocks of memory and search memory for a value (or values) match/mismatch.
Status	The Status Window displays status information such as the PC address, break address, real-time clock, inactive count, pass count, repetition count, emulation status, trace status, trace read percentage and trace trigger.
Symbols	The Symbols Window displays symbolic information for the loaded program, if available. Several display formats are available.
Trace	The Trace Window is used to display a trace of the most recent emulation. Several display formats are available. Note that the Trace Window is available only on those emulator systems that have trace memory.
Watch	The Watch Window is used to display information about watch expressions. You can think of watch expressions as peepholes into memory where you specify the

starting address symbolically (the name of a program variable, register or bit) or numerically (an expression) and where the displayed values are interpreted according to the data type of the expression (if available).

Chapter 6: Operational Considerations

The iceMASTER AD emulator is designed to be as close as is possible to an actual device. In most cases you will not be aware of any difference since the devices used to emulate are the actual microcontrollers themselves. Since we do need to know what is going on during emulation there are a few constraints placed upon us, and a few precautions you can take to prevent problems.

Static

Perhaps the most difficult problem anyone who uses MOS devices will face is static. You may go for years with no fault traceable to static, or you may blow every part you touch. The iceMASTER emulator can be as sensitive to static as any other circuit. The microcontroller devices in the probe cards are especially vulnerable since adding extra protection would change response characteristics. This would be a step away from the real world. The built-in protections internal to the devices are operative.

We do still recommend, however, that you take every precaution regarding static. The use of grounding straps, static free workstations, and a little extra care in handling the emulator (and any MOS part) can prevent troubles later.

Power

When starting an emulation session, always turn the emulator power on first, then apply power to your target system. This will ensure that any interface devices are initialized properly. If you need to test a power-up initialization routine in your target, power up the emulator first, load your program if necessary, begin execution of your program using the *Run|Reset|Target* command which will cause the emulator to wait for a reset to arrive from the target, then power up your target and be sure that the power-up sequence includes a valid reset after the target is initialized (which is a good design practice anyway). If you are working in a target application which uses less than +5V, this is acceptable if:

- 1) The microcontroller on the probe card can be powered from the target system, and
- 2) The voltage levels on the signals which we monitor meet minimum VIH and VIL levels defined for the operating voltage of the probe card. Note that the emulator base will monitor the RESET and CKI signals.

Please remember that we provide power for the microcontroller on the probe card (unless a jumper allows you to connect the VCC line to the target power pin(s)). Therefore, you should be sure the two VCC levels are close enough that the guaranteed logic high and low values are met. It is also necessary that you do not exceed the input pin voltage ratings of the devices on the probe card which allow communication with the base. COP8 probe cards

must be run within the rated voltage range for that probe card. If you have any questions about a specific application, please contact us.

Timers

880 and 8640 Probe Cards. Upon reaching a Break-point, the timer is shut off approximately 20 cycles after emulation stops. When emulation resumes, the timer is restarted approximately 16 cycles before emulation in the target application program actually begins.

884xx/888xx Probe Cards. There is no delay in stopping or restarting running timers upon reaching a Break-point or when emulation resumes.

Halt Mode

To allow clock resynchronization in the COP microcontroller, it is necessary to program two NOP's immediately after the processor comes out of the HALT mode. When the multi-input wakeup interrupt is enabled, the first two instructions of the interrupt routine must be NOP's. If no interrupt is used, then two NOP's must follow the "enter HALT mode" (set G7 data bit) instruction.

Idle Mode

As with the HALT mode, it is necessary to program two NOP's to allow clock resynchronization upon return from the IDLE mode. The NOP's are placed either at the beginning of the IDLE timer interrupt routine or immediately following the "enter IDLE mode" instruction.

888CF VREF and AGND Pins

The 888CF VREF and AGND signals are routed directly to the small adapter board pins (on the underside of the probe card) and are not connected to a source or ground on the probe card. As a result, when operating the probe card out of a target system (or in a target system without VREF and AGND), the I/ACH functionality of the 888CF microcontroller will not operate properly.

Watchdog Timer

Note that if a Watchdog service is attempted during the time of a Watchdog error (when the WDTOUT pin is low (active)), it is ignored. This is a potential problem as the state of the WDTOUT pin is NOT guaranteed at RESET, however, when using the emulator this problem will not appear. To ensure proper operation when not using the emulator your startup code must wait until the WDTOUT pin goes high before attempting the Watchdog service.

Probe Card Oscillator Circuit

Below is a schematic diagram of the oscillator circuit used on the COP8 probe card. The circuit uses an inverter as a Pierce Oscillator Amplifier to simulate the amplifier of the microcontroller.

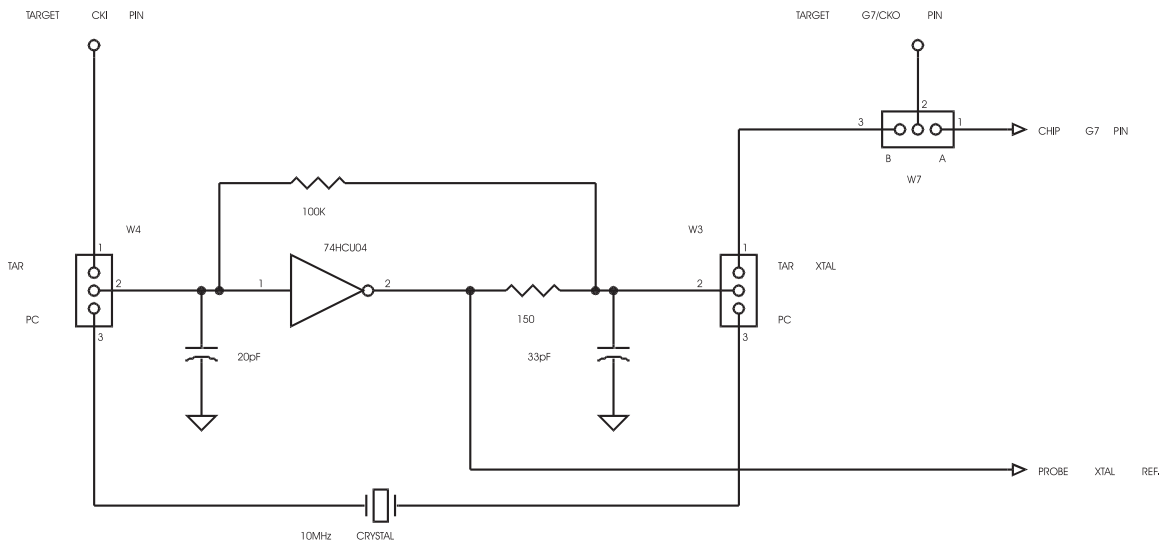


Figure 18. COP8 Probe Card Oscillator Schematic

When the W3 and W4 jumpers are set to PC, a 10MHz crystal is connected to the amplifier. The output of this circuit is buffered before driving the probe card's microcontroller CKI input. This allows the CKO/G7 pin to be available to the target system as the G7 input.

When the W3 and W4 jumpers are set to the TAR, the target system may provide either a crystal or clock driver input. To verify that a target system crystal is operating correctly with the probe card amplifier, view the signal on pin 11 of the 68-lead PLCC device nearest the W3, W4 jumper blocks. Pin 11 is the clock input to the microcontroller. The signal should be at the target crystal frequency with standard CMOS voltage levels. If the signal does not exhibit these characteristics, the resistor and capacitor values on the target system crystal circuit should be adjusted accordingly.

Chapter 7: Troubleshooting

Before starting any fault investigation, remove the emulator from the target system and configure the probe card for stand-alone operation. Make sure that all connectors are in good condition and fully seated. Take note of any physical damage to the unit.

Several common problems are covered in this chapter. If this isn't enough to get the emulator back into operation, contact MetaLink. With your knowledge of the application and MetaLink's knowledge of the emulator, many problems can be diagnosed within minutes.

Before Calling

Have the system near the phone so that problems may be "walked through". If the unit needs to be sent in for repair you will also need the following information:

- 1) the emulator's serial number (on the bottom of the emulator base unit),
- 2) the Host Software revision level (see the Identification Window),
- 3) the address to which MetaLink will ship the repaired unit.

Power Indicator LED Is Not Lit

If the power indicator LED is not lit, check the usual background details, such as that the power switch is ON, the power supply is connected to the base and there is power at the AC outlet. If these items are in order, make sure that +5V is delivered to the emulator's power connector by checking the output of the +5V power supply. Examine the emulator power connector drawing in the Hardware Description Chapter to determine the pin-outs for the male DIN connector.

Using a voltmeter, check the terminals of the power supply. If the output is correct, check the +5V at the probe card (with the emulator power switch ON). The easiest place to read this is across the large power filter capacitor on the probe card. If this reading is not +5V ($\pm 5\%$), the problem may be in either your emulator or in your power supply. If you have another power supply capable of providing +5V at 1.5 Amps ($\pm 5\%$), try it. If this does not solve the problem, the emulator needs to be repaired, contact MetaLink.

Active Indicator LED Is Not Lit

If the Active LED is not lit, make sure that the probe card's crystal jumpers are set correctly for the application. Refer to the Probe Card Reference for your probe card. The probe card

may be configured to support clock drivers for either CMOS or NMOS controllers, regardless of the technology of the microcontroller on the probe card. Make sure that the jumper blocks have not been damaged and are making good contact at their respective posts.

Once the crystal jumper block settings have been verified as correct, make sure that the Power Down mode or Idle mode of operation (CMOS controllers only) was not inadvertently invoked through software. A Reset is the only way to terminate the Power Down mode. If the Active LED stays unlighted, contact MetaLink.

Communications Failure

Make sure that the oscillator signal is present. If a crystal is used, the crystal itself may be damaged. Replace the crystal with an equivalent crystal if the no-signal condition remains. If the oscillator is present, check the probe card cable at its mating connectors. Also check the cable for damage which may have introduced a fault in the signal activity. Replace the cable with an equivalent if flaws are seen. Refer to the Hardware Installation chapter for details on the cable construction.

Next, compare the RS-232 cable with the illustration in the Hardware Description chapter. Replace the cable if needed. A “break-out box” will facilitate a check on the presence and level of the RS-232 signals on the cable. Active signals will be at a nominal 10V and the polarity may be plus or minus depending on the state the of the hardware. If no activity is seen on Pin 2 (Transmit) the Host Computer has a fault in its interface card. If Pin 2 is active and Pin 3 is inactive (not toggling) the emulator has a fault. A persistent fault may indicate that the probe card’s microcontroller has been damaged. Replace the controller with an equivalent. If the fault remains, contact MetaLink.

Emulation Problems

In stand-alone mode, load and run a demonstration program that is supplied on the distribution diskettes. If the program runs correctly, the problem may not be with the emulator but with the emulator target interface. Keep an open mind. Even in known good target systems, failures occur. It may even be possible for a “real” device to work in your target where the emulator has trouble. This is usually a problem with tolerances, not differences. If you encounter this, please call us so we can determine quickly where the problem lies.

Carefully consider the application:

- 1) verify that the emulator is configured properly
- 2) verify that mapping is set properly
- 3) look for unexpected resets (e.g., watchdog timers)

- 4) check interrupt routines for proper returns to normal code execution

If these procedures restore operation in the stand-alone mode, or if the unit worked in the stand-alone mode without correction, it is necessary to determine if the target is causing the fault or if the emulator has a fault that doesn't manifest in stand-alone mode.

Troubles to watch for include:

- 1) watchdog timer resets during BREAK condition
- 2) bus contention
- 3) excessive loading
- 4) failed components in the target system (especially failures that are likely to damage the probe card or emulator base)

Register Problems

If the value of a register in the Register Window is not what you expect, please take a moment to review the data book for the device in your probe card to see if any of the following situations apply:

- 1) some bits are not implemented
- 2) some bits are write-only
- 3) some bits have separate write/read functions
- 4) in the case of ports, writes to a register and reads from pins.

In most cases, one of the above situations is the cause of the confusion.

If you have any questions contact MetaLink for technical assistance.